

# Physics bulletin

## Physicists give the first law of thermodynamics a makeover

Research findings led by Paul Cassak, WVU professor and associate director of the WVU Center for Kinetic Plasma Physics, have broken new ground on how scientists can understand the first law of thermodynamics and how plasmas in space and laboratories get heated.

The first law of thermodynamics introduced in 1850s is only valid for systems in which a temperature can be precisely determined or in a state of equilibrium. As an example, combining a cup of cold water and a cup of hot water will eventually reach a warm temperature between them. This warm temperature is the equilibrium. However, when the hot and cold water have not yet reached that endpoint, the water is said to be out of equilibrium.

In many areas of modern science, systems are not in equilibrium. For over 100 years, researchers have expanded the first law for common materials not in equilibrium and such theories only work when the system is nearly reaching the equilibrium, for example, when the hot and cold water are almost mixed. The theories do not work in space plasmas, which are far from equilibrium. The work of Cassak and Barbhuiya fills in the blanks on this limitation.

Cassak said: "We generalised the first law of thermodynamics for systems that are not in equilibrium." He further added, "We did a pencil and paper calculation to find how much energy is associated with matter not being in equilibrium and it works irrespective of the system either close to or far from equilibrium."

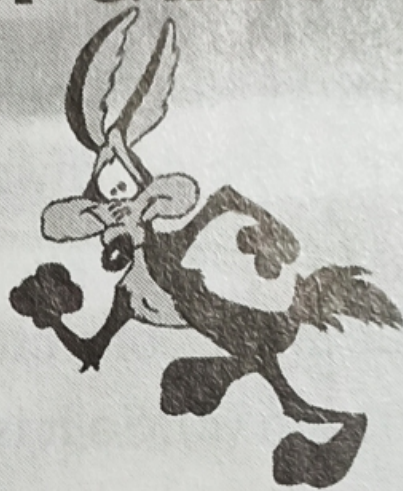
This research has numerous applications. The theory will help scientists understand plasma in space, which is important for planning for space weather. Space weather occurs when huge eruptions in the solar atmosphere blast superheated plasma into space. It can cause problems like power outages, interruptions to satellite communications and the rerouting of airplanes. The results could enhance our understanding of space weather events like mass coronal ejections from the Sun that release plumes of superheated plasma capable of interfering with communication systems and other technology here on the Earth.





## COMIC CAPSULE

### FIRST LAW OF CARTOON PHYSICS



"GRAVITY DOESN'T WORK UNTIL  
YOU LOOK DOWN"





The same THREE LETTERS will complete these three words.

Can you find the three-letter sequence?

ELECTRO — — — INESCENCE

— — — EN

PENDU — — —

*Readers can send their responses at [editor@mtg.in](mailto:editor@mtg.in) or post us with complete address by 10<sup>th</sup> of every month.*

*Winners' names will be published in next issue.*

# UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

## Column I

1. OUPND
2. IITGNILM
3. ALIENITSC
4. EPRWO
5. LCREIETCYTI
6. TENHALTETA
7. DAIIAATBC
8. ELPAMIDUT
9. SEROIMCCPO
10. RNOBO

## Column II

- (a) Amount of heat required to convert 1 gm of ice into water.
- (b) Instrument used to see very tiny objects.
- (c) Property of rubbed substances due to which they attract light objects.
- (d) Thermodynamical process in which there is no exchange of heat between system and surrounding.
- (e) The unit of mass in FPS system.
- (f) The type of collision in which two bodies stick their after collision.
- (g) Control rods used in nuclear reactor is made by.
- (h) The maximum value of static friction.
- (i) The maximum displacement of a wave from its mean position.
- (j) The rate of doing work.

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